UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

Enterprise Energy Efficiency (3E) Project

IQC Contract # EPP-I-00-03-00004-00
Task Order # 12

STUDENT DORMITORY "NIKOLA TESLA" IN BANJA LUKA

PILOT PROJECT PROPOSAL NO. B4-5

Author: Zoran Morvaj, Chief of Party

April 18, 2012

Implemented by:
Advanced Engineering Associates International, Inc. (AEAI)

This Proposal is made possible by support from the American People sponsored by United States Agency for International Development (USAID). The contents of this Proposal were prepared by and are the sole responsibility of Advanced Engineering Associates International, Inc., and do not necessarily reflect the views of USAID or the United States Government.

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Enterprise Energy Efficiency - 3E

PILOT PROJECT PROPOSAL NO. B4-5 STUDENT DORMITORY "NIKOLA TESLA" IN BANJA LUKA

SITE VISIT REPORT AND PILOT PROJECT PROPOSAL EVALUATION

HEATING DOMESTIC HOT WATER BY HEAT PUMP THAT EXTRACTS HEAT FROM WASTE WATER

Zoran Morvaj
Chief of Party

Sarajevo, April 18, 2012

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1. Pilot Project Proposal Screening Report

I Partners:
Student Dormitory "Nikola Tesla", Banja Luka

II Proposed EE Measures after USAID 3E Analysis:	
1. Heat pump control system (110 kW_{heat})	$70,000
2. Hot water tank, waste water separator, fittings, pipes and assembly	$25,000
5. Construction works (installation of a separator, …)	$10,000
6. Design and supervision	$10,000
Total cost of proposed EE measures	**$115,000**

III Co-funding Contributions:	
1. Direct co-funding from the partner's own funds;	$38,000
2. Partner co-funding from borrowed funds;	0
3. Other donors` co-funding:	0
4. Provision of works and services (e.g., dismantling of old equipment, installation of new equipment, design and supervision services, monitoring and verification (M&V));	0
5. Provision of materials and equipment (e.g., piping, wiring, insulation material, control equipment); and	0
6. Partnership with a private sector party that can contribute in any of the above.	0
Total confirmed co-funding by partner/donors:	**$38,000**

IV Co-funding by USAID 3E:	
Total 3E Project co-funding based on best estimate:	**$77,000**

V Compliance with Selection Criteria:		
1. Replicability potential and relative ease of implementation;	0 - 12	12
2. Readiness and ability to put in place clear M&V procedures for reporting on post-implementation energy savings;	0 - 12	12
3. Appropriate geographic location, building type and types of technologies so that the total portfolio of 10 pilot projects when implemented demonstrate various EE measures, technologies and practices used for different building types or EE practices and locations across the country;	0 - 24	24
4. Amount of co-financing for the pilot project that the partner is willing to or able to secure, or the amount of assistance the pilot project can obtain from other donors or private sector;	0 - 24	18
5. For the public sector - willingness to introduce energy management practices into other public buildings that are the partner's responsibility;	0 - 12	12
6. For municipalities - readiness to sign the EE EU Covenant of Mayors on;	0 - 4	4
7. For all – willingness to support raising EE awareness of building users and citizens generally.	0 - 12	10
Total:	**100%**	**92%**

VI Environmental Compliance:	
Confirm that the pilot project implementation does not cause any environmental concerns or adverse environmental effects.	Yes

2. Project Evaluation Summary

2.1 Basic data about the project:

- Students Dormitory "Nikola Tesla" is comprised of two pavilions with five floors each built in 1969 and 1971 (http://www.studentskiparlamentbl.com).
- It accommodates around 1000 students.
- The dormitory is connected to the district heating system.
- Domestic hot water is stored in two water tanks of 3000 liters each, which are currently heated by electric heaters. During the heating season, water is heated by heat energy from the district heating system. Plate heat exchangers are used for this purpose.
- The project proposes the construction of a heat pump which will extract heat from wastewater to heat domestic hot water for the student dormitory inhabitants. The heat capacity of the heat pump is 110 kW. Based on the available data, this system will be able to provide about one half of the current domestic hot water consumption. In the Detailed Energy Audit, the manner in which the heat pump will be integrated into the existing plumbing must be taken into consideration.
- The proposed technology is commercial, fully reliable and energy efficient. Such solution is applicable in many similar buildings in Bosnia and Herzegovina. In addition, this technology is efficiently used in larger building complexes.
- Data on current domestic hot water consumption and energy consumed for its heating is insufficient.

2.2 Recommended Measures:

1. Collect all wastewater into a separator to separate solid waste from the wastewater. There is enough space for the underground separator in the student dormitory yard.
2. The wastewater, at a temperature that varies from 15 to 20^{o}C is piped into the heat pump, where its heat is extracted to heat domestic cold water to the required temperature of domestic hot water of 60^{o}C (wastewater and domestic water flow in two separate loops and don't mix).
3. Installation of a heat pump with a capacity of 110 kW.
4. Installation of a connection to the present hot water preparation system.
5. Installation of a device for measuring, monitoring and system control.

2.3 Rationale:

1. The existing system for domestic hot water preparation is as old as the buildings themselves. Later, a heat exchanger was added to enable hot water use from the district heating system.
2. The characteristics of proposed commercial technology for the use of wastewater are as follows:
   - Energy saving
   - Only moderate initial capital required
   - Grants & rebates may be available
   - Greenhouse gas (GHG) emissions reduced
   - Provides opportunities for further expansion and innovation

3. Available data relevant to the amount of wastewater source (m^3/day) needs to be verified and supplemented in the course of the detailed energy audit.

2.4 Benefits:

- Practical demonstration of energy savings and improved comfort through regularly supplying the rooms with hot water
- Establish a monitoring & verification system
- Increase public awareness of benefits of energy efficiency measures
- Motivate local governments to financially support such projects
- Stimulate local economy through the participation in making parts of similar systems, their design and installation.
- Install a separator that reduces the pollution of watercourses
- Reduction of CO2 emissions
- Higher standard of living for dormitory's inhabitants
- Public health improvement through the reduction of gas emissions

3. Project Technical Description and Analysis

3.1Introduction

The City of Banja Luka has opted for an increase of energy efficiency and better use of renewable energy sources in their Sustainable Energy Action Plan (SEAP). With respect to all criteria, the proposed project meets the requirements for USAID 3E projects since it increases energy efficiency, reduces GHG emissions and promotes a commercial technology that has not been used on a large scale so far. In addition to the reduction of GHG emissions, the installation of a separator will also reduce the pollution of the watercourse as solid waste will be separated from the wastewater.

3.2 Site Visit Report

- The City of Banja Luka applied for a USAID 3E pilot project in order to obtain co-funding for projects that propose an energy efficient solution for a domestic hot water supply in the student dormitory.
- The total number of inhabitants in the "Nikola Tesla" student dormitory in Banja Luka is around 1000. There are some 310 bathrooms with shower cabins in the dormitory. The student restaurant and laundry are connected to the same sewer and they are the main sources of hot water which is by vertical pipes lowered to an underground horizontal pipeline network.
- Available data regarding the available wastewater (m^3/day) and its temperature is insufficient, and during the detailed energy audit, the data should be verified and supplemented.
- The project proposes the construction of a heat pump that will use wastewater heat as the heat source for a heat pump that heats domestic hot water for the inhabitants of the student dormitory. The heat capacity of the heat pump is 110 kW. However, the starting assumption is that the daily water consumption in the dormitory is 250 l/day/bathroom

and the heat pump is sized for half of this consumption. In the course of the detailed energy audit, the manner in which the new system for domestic hot water preparation will be integrated with the old one should be taken into consideration.

- The proposed technology is commercial, fully reliable and energy efficient. Such solution is applicable in many similar buildings in Bosnia and Herzegovina.
- During the field visit, a physical inspection of the dormitory consisting of two pavilions was done. These pavilions were built in 1969 and 1971. The dormitory is connected to the municipal district heating system. The preparation of hot water is done in two reservoirs, each with a capacity of $3m^3$, which contain electric heaters. During the winter season when the district heating system is operational, hot water from this system is used for the preparation of domestic hot water. One plate heat exchanger is used for this purpose. The system is controlled manually and is very inefficient.
- An illustration depicting the proposed system functionality is shown in Figure 1. As can be seen, the waste water is collected in a tank where the solid waste is separated from wastewater. The wastewater is then directed into a heat pump which uses the heat of wastewater to heat cold water. Additional details related to this project are shown in Figures 2-4.

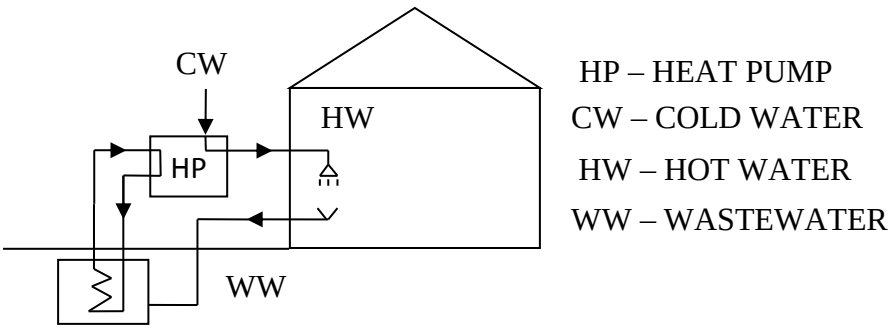

Figure 1: System illustration

Figure 2: One of 15-20 Manholes with Vertical Sewer

Figure 3: Plate Heat Exchanger for Domestic Hot Water Preparation

Figure 4: Vertical Water Tank and Electrical Heaters Heads

3.3Technical and Financial Analysis

The electricity prices used for calculations are as follows:

	Price KM/KWh	
	Winter (VS)	Summer (NS)
Higher tariff	0.141	0.1083
Lower tariff	0.071	0.0542

The estimated energy consumptions, before and after measures, for this building are shown in the following table:

Table 1: Energy Consumption

Energy Carrier	Unit	Present	After Measures	Savings
Electricity	$/year	100,000	65,000	35,000

The reduction of CO_2 emissions achieved by implementation of measures is as much as 83%.

The cost of measures and the payback period are shown in the following table. It is assumed that the price per kWh remains the same and that the payment for actual energy consumed is introduced.

Table 2: Preliminary Cost and Benefit Analysis for Recommended Measures

Measures	Investment [$]	Annual Savings Est [$]	Simple Payback Period [year]
Heat Pump for Wastewater Heat Recovery	115,000	35,000	3.3

3.4Conclusions and Recommendations

a. The proposed projects fulfills all USAID 3E project's criteria
b. The applied technology is commercial and modern
c. It is proposed to accept the project and to conduct detailed energy audit.

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LETTER FROM THE CITY OF BANJA LUKA ADMINISTRATION DEPARTMENT